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VANE TYPE COMPRESSOR
[Be-n'shiki asshukuki]

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Specification /541*

1. Title

Vane type compressor

2. Claims

A vane type compressor, which is composed of a cylinder with a tubular inner wall, a rotor which is provided inside the said cylinder and forms an adjacent part to the cylinder, multiple slits which are provided inside the said rotor in a radial pattern, and a vane which slides inside the slit, is characterized by the fact that to the innermost part of the slit, a spring made of an ultra elastic metal alloy is provided.

3. Detailed Explanation of the Invention

[Industrial Field of Application]

This invention pertains to a vane type compressor which is used for an automobile's air conditioner.

[Prior Art]

An automobile's air conditioner is now a necessity in terms of the comfort and safety of an automobile. Also, as the vehicle becomes fully furnished, use of the vane type compressor, which is characterized by its small size, tends to increase every year. Also, the vane type compressor has another great characteristic in that it is simple in its constitution and rotates smoothly. On the other hand, a subject which had long been researched on vane type

*Numbers in the margin indicate pagination in the foreign text.

compressors was a problem of the vane sound caused by the vane jumping phenomenon. This is a phenomenon which is generated when the vane passes in the vicinity of the adjacent part of the rotor and the cylinder and intricately relates to the pressure condition, the number of revolutions and the shape of the vane, etc. This problem has been basically solved by the mechanism shown below and is now produced on a commercial basis (for example, "Refrigeration and Air-conditioning Technologies", 82-11, vol. 33, No. 393. p.47).

Figures 6 and 7 depict a vane type compressor which has a vane jump prevention mechanism; in the figures, 1 represents a cylinder and 2 represents a rotor; in the rotor 2, there are multiple slits 3; in the slit, a vane 4 is inserted so as to freely rise or sink. 5 represents a side plate which holds the shaft of the rotor 2 and blocks the cylinder 1 from both the right and left sides. To a place on the side plate 5, which is located at the innermost part of the slit 3 of the rotor 2, a horseshoe oil groove 6 is provided. Into this oil groove 6, the refrigerating machine oil which has accumulated in the oil case 7, which is attached adjacent to the side plate 5, is pushed and supplied by the high pressure of the /542 compressor. The horseshoe oil groove 6 mentioned above is detailed further. The vane 4 is pushed out by the high-pressure oil supplied to the oil groove 6, is pressed so as to come into contact with the inner wall of the cylinder 1, and is operated, gradually compressing the refrigerant gas. As the vane 4 approaches the adjacent part 6 of

the cylinder 1 and the rotor 2, the gas pressure which acts on the tip end of the vane 4 by the compressed gas increases, approaching the backing pressure of the vane 4. At this point, the horseshoe oil groove 6 mentioned above completes the linking with the vane's back space. At this time, since the vane's back space 9 is filled with the refrigerating machine oil, a compressive effect is generated by an action in which the vane 4 gradually penetrates the slit 3, producing a high oil pressure. Thus, the pressure in the vane back space 9 becomes higher than the delivery pressure of the compressor, resulting in the vane 4 pressing against the inner wall of the cylinder with a strong force. Thus, the vane 4 is operated without breaking away from the inner wall of the cylinder.

[Problems that the Invention is to Solve]

However, the above constitution has an important prerequisite. That is, the refrigerating machine oil must remain in the oil groove 6. When considering the fact that an amount of residual oil in the rear case considerably fluctuates according to conditions such as the compressor's operating mode, pressure and temperature, and in view of the efficiency of the refrigerating cycle, the refrigerating machine oil tends to be reduced as much as possible, this prerequisite is a major problem which cannot be taken lightly.

[Means of Solving the Problems]

This invention, concerning the aforementioned problem, aims to provide a vane jump prevention mechanism by a different means without

relying on the refrigerating machine oil.

As this means, a vane type compressor is constituted so that to the innermost part of each one of the slits which are provided in a radial pattern, a spring made of an ultra-elastic metal alloy is provided.

[Operation of the Invention]

This invention, by the constitution mentioned above, uses the vane's penetrating action into the slit and has spring tension act in the interval when the vane passes the adjacent part of the rotor and the cylinder, preventing the vane's jumping phenomenon, and at the same time employs an ultra-elastic metal alloy, enabling the design of a spring with a high distortion factor, and utilizes the characteristics such that the spring tension does not become excessive in the elastic region, enabling the design of a compact spring.

[Embodiment of the Invention]

One embodiment of a vane type compressor of this invention is explained below referring to the figures.

Figure 1 depicts the constitution of the compression part in the first embodiment of a vane type compressor of this invention. In Figure 1, 11 represents a cylinder which has a pair of inlet openings 12 and a delivery opening 13. Inside the cylinder, a rotor 14 forms an adjacent part 15 to the said cylinder 11 and is provided in an eccentric arrangement. Inside the rotor, multiple slits 16 are formed

in a radial pattern; into its innermost part, a corrugated spring 17 which is made of an ultra-elastic metal alloy and is attached to the holding metal fitting 18, is inserted. Also, to the slit 16, a vane 19 is provided so as to rise or sink freely; it is constituted so that as the rotor 14 rotates, the refrigerant gas is compressed.

Figure 2 is an enlarged diagram of the rotor 14; the upper half of the diagram depicts a state in which the vane 19 has fully sunk into the slit 16; the corrugated spring 17 is considerably deformed, exhibiting the maximum spring tension. The lower half of the diagram depicts a state in which the vane 19 is protruded by the maximum stroke; the corrugated spring 17 is not deformed and separated from the vane 19; and the spring tension is not functioning.

In this case, Figure 3 depicts the property of the ultra-elastic spring. In the region with a small rate of deformation, the spring tension increases in proportion to the rate of deformation, but in the region beyond the elastic region, even if the rate of deformation increases, the spring tension does not increase much. When the rate of deformation is returned the original, a state, in which the spring tension is zero and the rate of deformation is zero, is restored with hysteresis but without generating the permanent strain.

Figure 4 depicts the relationship of the strength of force to the generation of the vane sound. That is, A represents a force pushing the tip of the vane in the sinking direction, and B represents a force inversely pressing the vane's rear tip against the

cylinder wall. Then, the crosshatching part D represents a region in which the vane is shifted in the direction to sink in the rotor, i.e. uncouples from the cylinder's inner wall due to force, and shows that the force is insufficient. Also, the broken line C depicts the magnitude of the spring tension (maximum F_k) which is fully compensating the said insufficient region and insufficient force. /543

As mentioned above, according to this example, a vane type compressor which is composed of a cylinder with a tubular inner wall, a rotor which is provided in the cylinder so as to form an adjacent part to the cylinder, multiple slits which are radially provided in the rotor, and a vane which slides in the slit, is constituted so that to the innermost part of the slit, a corrugated spring made of an ultra-elastic allow and a holding metal fitting which holds the spring are provided, making it possible to prevent the vane jumping phenomenon generated when the vane passes near the adjacent part of the rotor and the cylinder, and at the same time enabling the design of a spring with excellent durability.

Figure 5 is a detailed diagram of the rotor of the second exemplary vane type compressor of this invention. In this figure, 21 represents a coiled spring made of an ultra-elastic metal alloy which is furnished inside a guiding hole 23, which is provided to the bottom surface of the vane 22. Its functions and effects are identical to those of the first example.

Thus, even if the vane type compressor is constituted so that

the coiled spring made of an ultra-elastic metal alloy is inserted into the guiding hole, it is possible to prevent the vane jumping phenomenon by having the spring tension function when the vane passes near the adjacent part of the rotor to the cylinder, and at the same time it enables the design of a spring with excellent durability.

In this example, the cylinder with a round inner wall is shown, but an oval cylinder, which has two adjacent parts to the rotor, has the same effect.

[Effects of the Invention]

Thus, this invention constitutes a vane type compressor, which is composed of a cylinder with a tubular inner wall, a rotor which is provided in the cylinder so as to form an adjacent part to the cylinder, multiple slits which are radially provided in the rotor, and a vane which slides in the slit, so that to the innermost part of the slit, a corrugated spring made of an ultra-elastic metal alloy and a holding metal fitting which holds the spring are provided, making it possible to prevent the vane jumping phenomenon generated when the vane passes near the adjacent part of the cylinder to the rotor, and at the same time making it possible to design a spring with excellent durability.

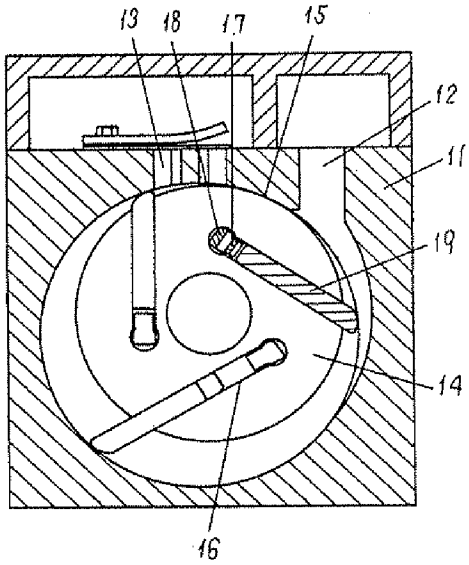
As a result, since a vane sound prevention mechanism, which does not rely on the refrigerating machine oil, can be provided and an amount of refrigerating machine oil can be substantially reduced, a highly efficient refrigerating cycle can be constituted.

4. Brief Explanation of the Figures

Figure 1 is a cross section of a compression part of the first exemplary vane type compressor of this invention. Figure 2 is a detail drawing of a rotation part. Figure 3 is a characteristic diagram of an ultra-elastic spring. Figure 4 is a distribution diagram of the force applied to the vane. Figure 5 is a detailed drawing of the rotation part in the second example. Figure 6 is a longitudinal cross section of an existing vane type compressor. Figure 7 is a cross sectional view of the same.

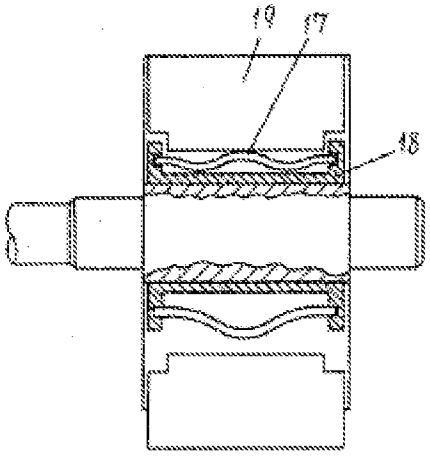
14 ... Rotor; 15 ... Adjacent part; 17 ... Corrugated spring; 18 ... Holding metal fitting; 21 ... Coiled spring

[Figure 1]

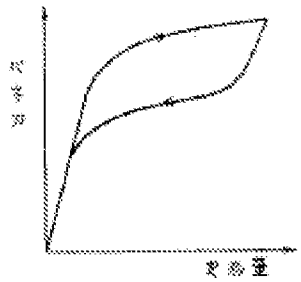


14 ... Rotor; 15 ... Adjacent part; 17 ... Corrugated spring; 18 ... Holding metal fitting; 21 ... Coiled spring

[Figure 2] /544

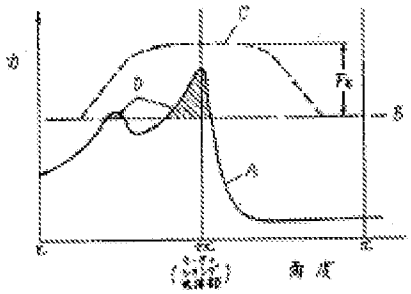


[Figure 3]



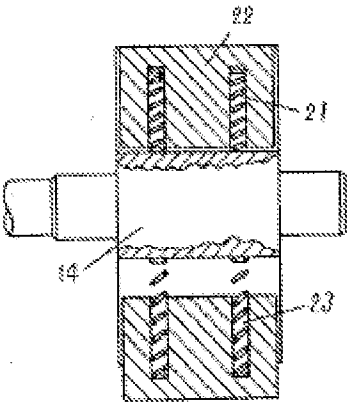
x ... Rate of deformation; y ... Spring tension

[Figure 4]

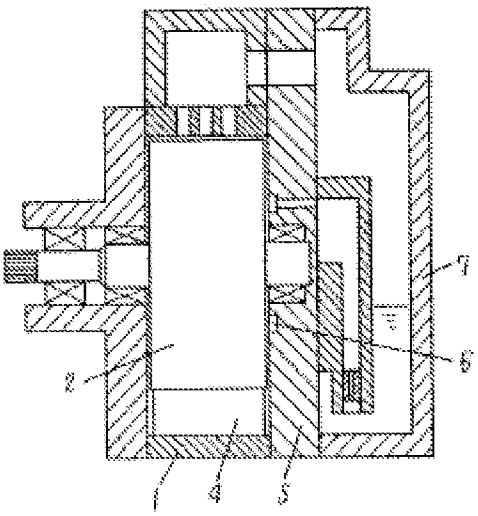


x ... Angle; y ... Force; 2π ... Rotor, Cylinder, Adjacent part

[Figure 5]



[Figure 6]



[Figure 7] /547